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ABSTRACT

Proof-writing is probably one of the most difficult skills for students to master in geometry. This may be due to the fact that students are not being taught the critical thinking skills necessary for proof-writing. The purpose of this paper is to illustrate how the ReQuest method can be used in the geometry classroom to improve students' question generation and proof-writing skills. In the first part of the treatment, a teacher must establish an atmosphere which is conductive to student participation and students will need to master the basic mechanics of questioning by modeling the teacher's questioning. The second step involves teaching students how to develop their own questions by turning sentences into questions and by having students take time asking and answering questions about given information. The last stage, proof-writing, is demonstrated by using the ReQuest method to collect the information necessary to write the proof. Several cautions for using this method are discussed. (YP)

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Utilizing the ReQuest Procedure for Proof-writing in Geometry

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Utilizing the ReQuest Procedure for Proof-writing in Geometry

Introduction

Proof-writing is probably one of the most difficult skills for students to master in geometry. This is largely due to the fact that students are not being taught the critical thinking skills necessary for proof-writing. Research has shown that much of the time spent during classroom instruction is focused on the memorization of facts. One reason for this is that most teachers find it easiest to teach lower level processes (IMP) (Bloom, 1978). The development of student questioning skills through the implementation of the ReQuest method developed by Manzo (1969) can provide teachers with an effective technique for helping students develop their critical thinking skills.

The Mathematical Dictionary (1976) defines a proof as being, "(1) The logical argument which establishes the truth of a statement. (2) The process of showing by means of an assumed logical process that what is to be proved follows

from certain previously proved or geometrically accepted propositions." In other words, the student must be able to take data in the form of diagrams, given information, definitions, and theorems, and use these data to reach a specific conclusion. Each statement in the proof must be derived from previous statements and must be justifiable through one of the forms of data listed above. This process requires that the student be able to analyze, synthesize, and evaluate data in order to find relationships between statements in the proof and determine whether or not these relationships are important to the completion of the proof. Critical thinking skills and self questioning skills are therefore essential to a student's ability to write proofs.

The ReQuest procedure is designed to teach students to generate questions independently. Because self-questioning is a major part of proof-writing, ReQuest is particularly well suited to this skill. This technique enables the learner to become more involved. In the ReQuest procedure, the students and teacher read a portion of their text silently, after which students are encouraged to generate questions to the teacher. After all student questions are exhuasted, the teacher models questions on all levels. Higher level questions are especially important since the type of questions the teacher asks will be coming back to the

teacher when the student questions. Every question asked should be answered as fully as possible. It is cheating for either the student or the teacher to withhold information or play dumb. If questions are unclear, the responder should ask for rephrasing or clarification. The responder should always be ready to justify his answer.

It is the purpose of this paper to illustrate how the ReQuest method can be used in the geometry classroom to improve students' question generation and proof-writing skills. A slight modification has been made, however, in that this author feels that basic self-questioning skills should be taught before beginning proof-writing.

Review of Related Literature

It has been shown through research that students can be taught to formulate their own questions (Rosenthal et al. 1970) with positive effects on comprehension question performance, quality and form of generated questions, and accuracy of predicted comprehension (Davey & McBride, 1986). This question generation can be an effective strategy for fascilitating learning from the text (Anderson, 1980).

Because self-questioning is an essential part of comprehension (Singer, 1978), and engages students in a deep

processing of text materials (Craig & Lockhart, 1972), many educational researchers, including Adler (1982), Sizer (1984) and Goodlad (1983), have stated that there is a need for more Socratic teaching (teaching by questioning) in our classrooms. This is especially important in the geometry classroom, because skill in question asking and problem finding is crucial to all problem solving in science and the arts (Gelzels & Csiksyenlminhalzi, 1976: Scardamalia & Bereiter, 1985), both of which are integral parts of geometry. The ReQuest procedure has been found to be an effective way of improving our students' self-questioning skills (Kay & Young, 1986: Davey & McBride, 1986: Manzo, 1969).

Procedure

The key to the ReQuest method is student involvement. Research has shown that in the typical classroom, the teacher talks from two-thirds to three-quarters of the time (Flanders, in Dunkin & Biddle, 1974, P. 137). The teacher must first, therefore, establish an atmosphere which is conducive to student participation. The environment should be one in which students feel comfortable about themselves, their relationship with each other, and with the teacher. "This kind of atmosphere is fundamental if students are to

feel free to talk." (Wing, 1982). A list of instructional strategies compiled by Barbara Wing (Wing, 1982) which the teacher can use to encourage student talk is provided in Table 1. Although this list of strategies is intended for language teachers, there are many which could be implemented in any content area classroom.

Next, students will need to master the basic mechanics of questioning. This process should begin with teacher modeling of good questioning. For example, the teacher might model questions about a diagram containing a linear pair (i.e. Is this a linear pair? If so, what can we say about these angles?). The teacher needs to provide many examples where he/she formulates questions about definitions, diagrams, etc.

The second step in teaching self-questioning involves teaching students how to develop their own questions by turning sentences into questions.

Example:

Teacher: A and B are complementary.

Student: If A and B are complementary, what can we say about them?

and by having students take turns asking and answering questions about given information. Question - answer sessions should be allowed to continue until information is

exhausted.

Once students have mastered questioning skills, they are ready to begin proof-writing. Using the ReQuest method, the students would be given a diagram and some information necessary to the writing of the proof. After studying the diagram and the given information, the students would ask the teacher questions relating to the material. At this stage, they should be able to look for meaning and to remember relationships. The teacher would respond to each question with just enough information to answer the question without any elaboration, hopefully encouraging more questions. All information found to be relevant to the solving of the proof would be put on the board for the class to study. When all student questions are answered, the teacher would then ask the students questions, modeling questions on higher levels. In this way, students are taught to use critical thinking skills, as modeled by the teacher, to collect the information necessary to write the proof. The only step remaining is to put their findings and justifications into the accepted two-column form. This procedure should also be modeled by the teacher.

Discussion

This method, although felt by the author to be an

effective means of teaching proof-writing, will require much patience and tolerance from the teacher. Students are not always going to ask the questions we expect and want them to ask, they may have trouble stating their questions clearly, and they may even ask questions we can't answer. There are certain things the teacher can do, however, which will make this procedure more effective. A slow pace needs to be set to give time for reflection and time for each student to respond. It is very important that silence be maintained during time provided for reflection. The first hand up should not always be recognized. An effort must be made by the teacher to call on slower students, allowing them plenty of time to think their answers through. Most importantly, all students must be required to participate. If students know they are going to be called on, they will put more thought into the formulation of their questions.

Summary

Research has shown that more emphasis needs to be put on the development of student questioning skills. As stated in the Postman and Weingartner study (Perez, 1986), "The art and science of asking questions is the source of all knowledge. Any curriculum of a new education would, therefore, have to be centered around question asking..."

In the words of Einstein (Yager, 1987), "The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advances in science."

In a time when the major cause for student dropouts is dislike of school, perhaps we need to put the spark back into learning. Only when the student is allowed to be an active participant in the creative process of learning will she/he once more find the joy which can come through learning.

Table 1

INSTRUCTIONAL STRATEGIES
FOR
ENCOURAGING STUDENT TALK

1. Provide a "content-rich" environment by
   - using the target language for all talk
   - talking about things that are significant to the student
   - relating topics of class lessons to the students' lives and contempory issues

2. Help students to understand by
   - using shorter sentences and simpler sentence constructions
   - speaking more slowly and pausing between utterances to allow for processing of the message
   - repeating, expanding and rephrasing what you say

3. Invite students to participate by
   - giving frequent instructions
   - acknowledging their verbal and non-verbal activity
   - making corrections regarding the "truth value" of what they say
   - requesting information only they can provide

4. Use non-verbal cues, such as
   - gestures and pantomime
   - visuals
   - realia

5. Listen for meaning, not form, and
   - let students finish talking without interrupting them
   - give students time to rephrase and self-correct
   - correct only the errors that interfere with meaning

6. Provide activities that engage students by
   - requiring them to discover new information and use it meaningfully
   - make them complete real tasks through communicating with each other
   - placing them in a situation where interaction and cooperation is the key to success

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